BIBLIOTHEQUE,
ARCHIVES PUBLIQUES,
OTTAWA, ONT.

(All rights reserved.)

ADVANCE PROOF—*(Subject to revision).*

This Proof is sent to you for discussion only, and on the express understanding that it is not to be used for any other purpose whatsoever.—*(See Sec. 40 of the Constitution.)*

Canadian Society of Civil Engineers.

INCORPORATED 1887.

N.B.—This Society, as a body, does not hold itself responsible for the facts and opinions stated in any of its publications.

SCREENING OF SOFT COAL.

By J. S. McLennan, A. Can. Soc. C.E.

(To be read 31st Jany. or 14th Feby.)

Coal comes from the pit to the surface as the miner has broken it down. He loads into the tubs the lumps and fine coal made by his pick in holing or undermining his shot, or in breaking up the large mass which is tumbled over as its result. In mines where a layer of stone adheres to the top of the seam, he is bound under a penalty to clear this off. But with other foreign matters found in the coal he has no concern. Roughly speaking, few seams are absolutely free from such impurities, and to bring the coal to its best merchantable condition, these must be removed as far as possible. When this has been done the coal is "run of mine" in the commercial sense. Round coal is that which passes over a screen, the bars of which have between them apertures of $\frac{1}{2}$ to $\frac{3}{4}$ of an inch. Slack is the coal which falls through these apertures, and it is often passed through a secondary screen and divided into nut and duff.

The desiderata in screening are therefore:—

I. Effective separation of sizes; so that slack may not be carried among the lumps into the round coal, or so that, in avoiding this by wide openings between the bars, too large coal may not pass into the slack, a consideration of some importance in shipping slack to the United States, where an excessive size would render the cargo liable to a higher rate of duty.

II. An opportunity for the removal of mechanical impurities as stone or pyrites, which occur in some mines as "balls," or elsewhere in laminations so thickly grouped, as to be easily visible.

III. The minimum of breakage in the transit, from the pit tub to the railway car, the vertical distance between the levels of which is from 15 to 25 feet.

The ordinary method of screening is by a fixed screen about 20 feet long and 6 feet wide, inclined at an angle of about 25°. The effective screening surface is reduced in many cases, by the use of cast iron bars about $\frac{3}{4}$ inch thick. The tub is commonly provided with an end door, and, when run on a tumbling cage, it is tipped into contact with the upper end of the screen. The door is opened automatically or by the attendant, and the coal slides down the screen. As there is no means of regulating its speed, it very imperfectly fulfils all the conditions of screening coal, except rapidity, as it is obvious that coal can be sent down it as rapidly as tubs can be tipped; but it is not separated effectively, no opportunity for picking is given, and the breakage of the lump coal and also of railway cars is excessive.

The method of screening adopted by Mr. Poole, at the Acadia Colliery in Pictou county, is effective and economical. He describes it as follows:—

Coal is drawn from the mine up an incline of 24° to 28° in boxes holding a ton each. The boxes have end doors, and are run forward on the bank head, 28 feet above the main railway, to a rocker. The loaded box tilts up, the door is released, and the coal slides out on to a dead plate at the head of the screens.

The dead plate, 3 ft. wide, dips at an angle of 40°. From its lower edge proceed two sets of bars which we may call A and B. A is 5 ft. long and is made of 2 in. bars placed 6 in. apart. It inclines at an angle of 21°. To its distal end is hinged an apron 12 ft. long, ordinarily lying at the same inclination. The free end of the apron is sustained by a counter weight. When the weight is down and the apron up, the passage over its upper surface is closed by a fixed stop suspended from above, at a point two-thirds of the distance from the proximal end.

The "B" set of screen bars are 12 ft. long, of 1 in. sq. iron and $\frac{3}{4}$ in. apart; they start from the head plate under the heavy bars at an inclination of 45°, and continue at a lessening inclination until an angle of 21° is reached, at which inclination the screen then remains. A hopper under these bars collects the "slack" coal that has fallen through, at the lower end of this screen; a short fixed screen 2 ft. 6 in. long with $2\frac{1}{2}$ in. openings separates *out* the "stove" size. Thence onward the screen is lined with imperforate plates, and terminates in a counterbalanced apron 4 ft. wide, which, as required, checks the flow of coal over the screen and enables stony coal, etc., to be seen and removed; or entirely stops the flow, and allows coal to accumulate while cars below are being shifted.

The object of the coarse screen A is to separate out "furnace" coal, and the separation of very large lumps from the run of mine enables a more thorough screening of the remainder to be effected. The furnace coal slides forward on the apron and collects against the fixed stop. When the apron is full, the screenman lifts a brake from the counterbalance, and the apron then descends until the point rests on the regular screen; while it is descending, the coal upon it is slowly sliding forward, and thence passes quietly on without a drop into the car below.

The slack collected in the hopper under the screen, drops into a well, from which it is elevated to the level of the bank head, and dropped into a revolving screen 12 ft. long by 4 ft. diameter, covered with wire cloth of $\frac{3}{8}$ in. mesh. This screen separates the slack into "nut" and "culm."

The above will make clear the arrangement at Westville; at the other pits the ordinary screen is in use.

The arrangements at "Acadia," which are thoroughly effective, require a high bank head to give space for the screens, and thus were not available as models, when the writer decided to change the screens he found in place at the International mines. Notwithstanding Mr. Poole's kind assistance, some other device had to be used, which could be placed in a bank head only 21 feet high. No other screens are in use in Nova Scotia, and the apparatus known as Regg's patent Curved Balance Screen was imported from England. It is figured in Plate II, Figs. 1 and 2, and consists in the tipping cage shown in Fig. II, in the position in which the loaded tub is pushed into it. It is retained in position by angle irons, which project beyond and slightly above its edges. The lever shown in the sketch which operates the hand brake is partially released, and the whole cage turns over slowly until it reaches the position shown in I; the coal slides out of the tub on the screen, and by gravity the cage assumes its former position. The tubs are "solid," that is without end doors, and thus save a good deal in repairs, the doors being those parts most liable to get out of order.

The screen is 6 ft. wide and 11 ft. long from the top to the journal shaft which supports it, and thence to the mouth 13 ft. in length. To the journal shaft is keyed a large brake wheel, the band brake on which is controlled by a bell crank lever indicated in both sketches. The angle of inclination of the upper part is 25°, and of the lower 8°. The momentum of the coal from the tub carries it forward to the lower part of the screen, where it lies until it is inspected, and, if necessary, cleaned; then, on the release of the brake, its weight causes the screen to tilt downwards, until the coal slides gently into the car. When the weight is removed the screen returns to its former position.

It will be seen, that, in giving a chance for cleaning the coal and saving of breakage, it is perfect, and very good for separation of sizes. It is however slow, and by requiring more screens is thus more expensive for a given output than the old type. Its first cost is high, and consequently, a modification, suggested by Mr. John Johnston, the underground manager, has been adopted. This is shown in Figs. III and IV. The screen is the same length, but is 7ft. 6ins. wide. The upper part is fixed at an angle of 28in. to 30in.

The lower part rests on a journal at X, and is supported by a counter-weight W, controlled by a brake B around which the connecting wire rope passes. The Regg's cage is used with this screen. When the coal is ready to be deposited in the car, the brake is released, and the point of the screen descends as in Fig. IV. When the coal is off, the counter-weight brings the screen back into the position in Fig. III. In Figs. I and II is shown the box in which slack is caught and deposited in a car. In the other is indicated at E an endless chain conveyor, which carries it to an elevator to the subsidiary screen on the bank head, where the nut coal is taken out.

While this system is more costly than the normal type, its efficiency more than compensates for the cost in giving a cleaner and larger coal than was formerly obtained.

The Old Sydney and Victoria Mines employ an apparatus known as the Billy Fairplay which Mr. Brown, the manager, has kindly described for this paper. He says:—

"The Billy Fairplay" system is in use at the Sydney mines of the General Mining Association, Limited.

By this method the coal is not riddled in the pit by the colliers, but is filled by them just as it is cut, into the tubs or boxes, the large and small or slack coal all together. On arrival at the surface, the tub of coal is weighed, and the gross weight of the coal it contains is recorded. It is then dumped into the screens; the screened large coal passes over the bars of the screen into the cars, and the slack coal passes through the spaces between the bars of the screen into a hopper.

From this hopper the slack coal falls into a tray which hangs suspended on pivots from an indicating dial overhead. When all the slack from a tub of coal has thus gone into the tray, its weight is ascertained by the dial, and the tray is then capsized by a string pulled by a small boy stationed at the screen for the purpose, and the empty tray resumes its original position ready for the next tub of coal.

The gross weight of the coal that was in the tub is placed to the credit of the collier who sent it up, and the weight of slack that has been screened from that tub is placed to his debit; he is paid a certain price per ton, only on the difference, that is, the screened large coal.

The advantages of this system are, that the colliers are saved the labor of riddling their coal by hand, and that it discriminates in favor of the skilful workman, who hews his coal with a view to make as little slack as possible, and gives him, as he deserves, better pay than the careless miner, who breaks up an undue proportion of the coal which he produces.

The slack coal is emptied by the capsized tray into a small tub. This tub, when full, is drawn up a steep incline by means of a small engine and wire rope, and when arriving at the top it automatically empties itself.

The slack coal from the tub falls upon an oscillating screen composed of wire netting of half inch square mesh, which separates it into nut and duff, each of which passes through a shute into a car of its own on the railroad below. If slack coal is at any time desired in the cars instead of nut and duff, then the wire netting screen is not used.

The Billy Fairplay system is largely used in Wales and in the north of England.

It may be noted that, while the "Billy Fairplay" is a very valuable incentive to the miner to reduce the slack to a minimum, the practice of riddling coal in the pit to which Mr. Brown refers has been abandoned by all but one or two mines in Cape Breton and Nova Scotia. The English practice is very elaborate at the best collieries. Screens, having bars with reciprocal motion carrying the coal along, circular screens revolving horizontally, so that different bands of coal can be sorted into different cars, are in use, all of them elaborately explained in Percy's Mechanical Engineering of Collieries. In the Pillsbury region, the screening appliances are good. In many cases a very high bank head allows enough assorting of the different sizes through a succession of screens into different cars; but while. It may not be true of other departments of the industry, the best practice in screening in this province is abreast of the times.